

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2224 Ship and Submarine Hull, Mechanical and Electrical (HM&E) Advanced Technology	33,551	35,222	39,105	35,353	34,308	35,066	36,224	36,976	CONT.	CONT.
R2328 Project M	4,722	4,697	2,410	0	0	0	0	0	0	20,833
R2373 Composite Helicopter Hanger (Congressional Plus up)	9,591	4,989	0	0	0	0	0	0	0	14,580
R2488 Power Electronic Building Blocks (Congressional Plus up)	0	5,986	0	0	0	0	0	0	0	5,986
R2489 Power Node Control Centers (Congressional Plus up)	0	1,995	0	0	0	0	0	0	0	1,995
S1848 Gas Turbine Engine Technology	505	0	0	0	0	0	0	0	0	100,865
TOTAL	48,369	52,889	41,515	35,353	34,308	35,066	36,224	36,976	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) provides for the continued development of affordable surface ship and submarine hull, mechanical, and electrical system core technology demonstrations that contribute to meeting top joint warfare capabilities established by the Joint Chiefs of Staff; namely, to promptly engage regional forces in decisive combat on a global level.

(U) In FY 2000, there are two active projects: Ship and Submarine HM&E Advanced Technology (R2224), and Project M (R2328). Products from this PE will improve the effectiveness and operational efficiency of all Navy ship and submarine platforms in all Joint Mission Areas. Affordability is addressed through large-scale demonstrations and validation of concepts that reduce costs associated with design, fabrication, outfitting, maintenance, and operation. All naval platforms inherently

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 1 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology

require mobility, efficiency, reliability, and availability as primary requirements for Naval Warfare. This program directly supports the Readiness and Support and Infrastructure Joint Mission Areas in the area of sustainability and supports Strike, Littoral Warfare, Joint Surveillance, Joint Surface Electronic Warfare, Strategic Deterrence, and Maritime Support for Land Forces, and Strategic Sealift relative to reduced signatures and increased survivability.

(U) The Navy S&T program includes projects that focus on or have attributes that enhance the affordability of warfighting systems.

(U) JUSTIFICATION FOR BUDGET ACTIVITY: This program is budgeted within the ADVANCED TECHNOLOGY DEVELOPMENT Budget Activity 3 because it encompasses development, simulation, or experimental testing of prototype hardware to validate technological feasibility and/or concept of operations and to reduce technological risk prior to initiation of a new acquisition program or transition to an ongoing acquisition program.

(U) PROGRAM CHANGE FOR TOTAL P.E.:

	<u>FY 1998</u>	<u>FY 1999</u>	<u>FY 2000</u>
(U) FY 1999 President's Budget:	48,261	39,264	42,165
(U) Appropriated Value:		51,264	-
(U) Adjustments from FY 1999 PRESBUD:	+108	+13,625	-650
(U) FY 2000 President's Budget Submission:	48,369	52,889	41,515

(U) CHANGE SUMMARY EXPLANATION:

- (U) Funding: FY 1998 adjustments reflect Small Business Innovative Research reduction (-\$423), Federal technology transfer (-\$20) and actual update adjustments (+\$551). FY 1999 adjustments reflect miscellaneous adjustments (+\$1,798), Congressional Undistributed Reductions (-\$173), specific Congressional reduction (-\$1,000) and Congressional plus ups: Composite Helicopter Hangar (+\$5,000), Pover Electronic Building Blocks

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 2 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROGRAM ELEMENT TITLE: Surface Ship & Submarine HM&E Advanced Technology

(+\$6,000), and Power Node Control Centers (+\$2,000). FY 2000 changes reflect Navy Working Capital Fund rate adjustments (+\$286), Civilian pay adjustments (-\$455), program balance adjustment (-\$3,431) and affordability transfer (+\$2,950).

- (U) Schedule: Not applicable.
- (U) Technical: Not applicable.

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 3 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

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(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2224 Ship and Submarine Hull, Mechanical and Electrical (HM&E) Advanced Technology	33,551	35,222	39,105	35,353	34,308	35,066	36,224	36,976	CONT.	CONT.

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Project R2224 develops and demonstrates technological improvements for Ship and Submarine Hull, Mechanical, and Electrical (HM&E) systems in support of present and future surface ship and submarine platforms. This project demonstrates technology that has been explored for system feasibility at the applied research level, primarily in PE 0602121N, and focuses on system level development and demonstration for transition to higher budget category funding, or acquisition programs. Thus, this project is a continuing effort that demonstrates system technology to improve overall platform performance (stealth, affordability, survivability, mobility, efficiency, reliability and availability) and reduces maintenance, overhaul, and life cycle costs. Areas of current technology development and demonstration are Advanced Vibration Reducer (AVR), Automation to Reduce Manning (ARM), Ship/Submarine Hull Systems (SSHS), and Advanced Electrical Systems (AES). Project M efforts are reported in Project R2328.

(U) AVR technology reduces submarine acoustic signature. This technology addresses general submarine signature issues and is applicable to current and future submarine classes. AVR technology has been demonstrated through an at-sea acoustic ship trial.

(U) ARM technology develops sensing, control, actuation and decision making technology to enable reduction in manning for future ships and submarines. This effort is currently focused on Damage Control Automation to Reduce Manning (DCARM) and Affordable Interfaces for Optimal Manning on the family of 21st century combatants (SC21 Manning). DCARM is transitioning automated damage control technology options for the family of 21st Century Combatants and the CVX. DCARM technology will be demonstrated in a series of system tests culminating in a final integrated demonstration of a survivable HM&E damage control

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 4 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine
HM&E Advanced Technology

system. SC21 Manning will demonstrate at least 50% manning reduction in surface ship combat systems through human-centered systems engineering and advanced watchstation design for the new destroyer class of surface combatants (DD21).

(U) SSSH develops and demonstrates system level technology from a multi-disciplinary approach; the Advanced Machinery Support Structures (AMSS) effort is focused on modular structures for submarine machinery spaces, to demonstrate a unified system that controls shock, acoustic vibration, and radiated noise. This technology enables use of affordable modular construction, and commercial-off-the-shelf equipment. The Integrated Ship Hull Form/Propulsor System (ISPS) effort will demonstrate the integration of multi-disciplinary technologies, in particular, the integration of hydrodynamic, mechanical, and structural technology into ship hull/propulsion systems. The Advanced Topside Systems (ATS) effort will demonstrate general ship topside technologies for future ship classes.

(U) AES demonstrates technology that will provide the fleet with: 1) Ship Service Fuel Cells (SSFC) as an affordable alternative electrical source for ship service power, this technology addresses improvements in power density, fuel consumption, manning requirements, quiet operation, and emissions. Emphasis is placed on leveraging commercial fuel cell technology and solving Navy issues such as operation in salt-laden air, shipboard shock and vibration, and reforming diesel fuel. 2) Quiet Electric Drive (QED) technology for passive and active suppression of acoustic and electrical noise associated with electric motors. This technology is focused on submarine applications and enables cost savings, improved quieting and radically new arrangements of propulsion and auxiliary machinery. 3) Advanced Electrical Distribution (AED) to enable an electrically reconfigurable ship to have a survivable fight-through capability for all electrical shipboard systems during battle. This technology will contain intelligent electric power control modules, thereby creating a new paradigm in power network architectures and system control well beyond conventional capability. It will provide automatic, reconfigurable electric power distribution systems that are redundant, survivable, and reliable with high quality power for ships and submarines. Solid State Switching Applications (SSSA) integrate Power Electronic Building Blocks (PEBB) into each of the above electrical technology demonstrations and provide the key undergirding technology for AES. This technology demonstrates the form, fit, and function of universal PEBB modules in shipboard system applications such as circuit breakers, current limiters, inverters, converters, motor controllers, etc. This multi-functional software controlled modular design reduces size, cost and weight of all electrical systems.

(U) PROGRAM ACCOMPLISHMENT AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS:

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 5 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine
HM&E Advanced Technology

(U)(\$1,997) AVR:

(U) COMPLETED:

- (U) Evaluation of at-sea test data.
- (U) Final reports documenting AVR program and transition advanced technology to Naval Sea Systems Command (NAVSEA).

(U)(\$9,097) ARM:

(U) INITIATED:

- (U) Selection of automated reasoning and control topology for automated ship damage control system. (DCARM)
- (U) Selection of human-centered designed systems engineering tools for optimized manning. (SC21 Manning)

(U) CONTINUED:

- (U) Development of automated casualty response systems to minimize manning and increase operational reliability. (DCARM)
- (U) Develop human-system performance metrics and predictive engineering models of combat systems decision-makers in warfighting scenarios. (SC21 Manning)
- (U) Develop integrated command environment concept for DD21 land attack mission. (SC21 Manning)
- (U) Evaluate individual multi-modal watchstation console effectiveness in DD21 air dominance and strike scenarios. (SC21 Manning)

(U) COMPLETED:

- (U) Fire and fluid control of damage detection requirements for automated ship damage control system. (DCARM)
- (U) Demonstration to establish baseline for automated ship damage control system. (DCARM)

(U)(\$13,908) AES:

(U) TRANSITIONED:

- (U) Tools developed in the Submarine Technology Applied Research program to predict two-dimensional electric motor forces. (QED)

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 6 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine
HM&E Advanced Technology

- (U) Diesel fuel processing technology for fuel cells from PE 0602121N. (SSFC)
- (U) CONTINUED:
 - (U) Construction of small-scale motor variants to evaluate measurement techniques and passive design parameters in quiet electric motors. (QED)
 - (U) Generate baseline force and acoustic measurements and predictions of small-scale electric motor variants. (QED)
 - (U) Develop concepts for a 2500 kilowatt Ship Service Fuel Cell power systems. (SSFC).
 - (U) Electrically Re-configurable Ship concept. (SSSA)
 - (U) Demonstration of key equipment capabilities for the Electrically Re-configurable Ship. (SSSA)
- (U)(\$3,549) SSHS:
- (U) TRANSITIONED:
 - (U) Transition technology from PE 0602121N for development of Machinery Support Systems (AMSS) for improved shock and acoustic performance. (AMSS)
- (U) CONTINUED:
 - (U) Evaluation of the impact of flexible truss and shock strengthening concepts on acoustic and shock performance of truss. (AMSS)
 - (U) Evaluation of coating optimization through simulation. (AMSS)
 - (U) Demonstration of coating holiday impact on radiated noise. (AMSS)
 - (U) Fabrication of advanced enclosed mast test article for the LPD-17. (ATS)
- (U) (\$5,000) Project M:
- (U) CONTINUED:
 - (U) This is included in the effort described in Project R2328 of this PE.

2. (U) FY 1999 PLAN:

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 7 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine
HM&E Advanced Technology

(U) (\$12,955) ARM:

(U) INITIATE:

- (U) Preparation for remote manual demonstration with 60% damage control manning reduction. (DCARM)
- (U) Develop and optimize water mist distribution controls and logic architecture. (DCARM)

(U) CONTINUE:

- (U) Land-based sensor evaluation to verify performance and environmental acceptability for automated ship damage control systems. (DCARM)
- (U) Development and programming of the supervisory control processor for the automated ship damage control system. (DCARM)
- (U) Develop and install integrated control topology for damage control. (DCARM)
- (U) Validation of initial fire suppression water mist system. (DCARM)
- (U) Development of systems engineering tool set for human centric systems. (SC21 Manning)
- (U) Develop and evaluate human-system performance metrics and predictive engineering models of combat systems decision-makers in warfighting scenarios. (SC21 Manning)
- (U) Development of Multi-Modal Watchstation team designs for DD21 warfighting missions. (SC21 Manning)

(U) COMPLETE:

- (U) Final Demonstration of 3-man Multi-Modal Watchstation team performance for current generation of surface combatants (AEGIS) Strike scenarios. (SC21 Manning)

(U) (\$16,501) AES:

(U) INITIATE:

- (U) Development of 3D models for electric motor magnetic fields. (QED)
- (U) Development of active control techniques for electric motors. (QED)

(U) CONTINUE:

- (U) Fabrication of a 500KW sub-scale demonstration model of the reformed diesel-fuel cell system. (SSFC)
- (U) Propulsion system concept studies. (QED)
- (U) Development of motor acoustic prediction capability. (QED)

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 8 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine
HM&E Advanced Technology

- (U) Development of critical component technology for intermediate-scale QED demonstration. (QED)
- (U) Demonstration of key system capabilities for the Electrically Reconfigurable Ship. (AED)
- (U) COMPLETE:
 - (U) Demonstration of prototype self-synthesizing, dynamically re-configurable electric distribution systems. (AED)
 - (U) Ship Service Fuel Cell power system concept validation via numerical analysis, and testing of sub-scale articles. (SSFC)
 - (U) Demonstration of physical and computational network system simulations. (AED)
 - (U) Multi-functional demonstration of second-generation PEBB modules for form and function. (SSSA)
 - (U) Demonstration of key equipment capabilities for the Electrically Re-configurable Ship. (SSSA)
- (U) (\$5,368) SSHS:
 - (U) INITIATE:
 - (U) In-air quarter-scale demonstration of Machinery Support Structure system concept for shock performance. (AMSS)
 - (U) CONTINUE:
 - (U) Evaluation of the impact of flexible truss and shock strengthening concepts on acoustic performance of truss. (AMSS)
 - (U) COMPLETE:
 - (U) Design guidance for coating holidays. (AMSS)
 - (U) Evaluation of coating optimization through simulation. (AMSS)
 - (U) Fabrication and demonstration of advanced mast test article for the LDP-17. (ATS)
- (U) (\$398) SMALL BUSINESS INNOVATION RESEARCH:
 - (U) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C.638.

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 9 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine
HM&E Advanced Technology

3. (U) FY 2000 PLAN:

(U) (\$14,133) ARM:

(U) INITIATE:

- (U) Casualty response/system reconfiguration for reflexive fluid systems (DCARM)

(U) CONTINUE:

- (U) Sensor evaluation to verify performance and environmental acceptability for automated ship damage control systems. (DCARM)
- (U) Installation of automated control topology for damage control (DCARM)
- (U) Development and programming of the supervisory control processor for the automated ship damage control system. (DCARM)
- (U) Develop systems engineering tool set supporting design for humans as critical system elements. (SC21 Manning)

(U) COMPLETE:

- (U) Water mist distribution controls and logic architecture (DCARM)
- (U) Complete hardware and software systems integration of fire protection systems (DCARM)
- (U) Complete casualty response/ system reconfiguration for reflexive fluid systems (DCARM)
- (U) Remote manual demonstration with 60% Damage Control Manning Reduction (DCARM)
- (U) Final Demonstration and evaluation of Multi-Modal Watchstation individual and team performance for DD21 warfighting missions. (SC21 Manning)

(U) (\$17,967) AES:

(U) INITIATE:

- (U) Development of acoustic prediction capability for electric motors. (QED)
- (U) Development of structural response models for electric motors. (QED)
- (U) Development of models for electric motor controllers. (QED)
- (U) Integration of submarine hydroacoustic model and structural response model. (QED)

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 10 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine
HM&E Advanced Technology

- (U) Development of scale electric motors and controllers for demonstration. (QED)
- (U) Demonstration of equipment capabilities using PEBB-3 technology. (AED)
- (U) CONTINUE:
 - (U) Demonstration of key system capabilities for the Electrically Re-configurable Ship. (AED)
 - (U) Development of active control techniques for electric motors. (QED)
- (U) COMPLETE:
 - (U) Demonstration of Virtual Test Bed for advanced PEBB based equipment. (AED)
 - (U) Development of 3D models for electric motor magnetic fields (QED)
- (U) (\$7,005) SSHA:
- (U) TRANSITION:
 - (U) Acoustic coating design methods from PE 0602121N. (AMSS)
- (U) INITIATE:
 - (U) Design and installation of advanced acoustic coating concept for quarter-scale demonstration at ISMS. (AMSS)
 - Demonstration of quiet piping system concept. (AMSS)
- (U) CONTINUE:
 - (U) In-water quarter-scale demonstration of shock capable Machinery Support Structure System Concept acoustic performance at ISMS. (AMSS)
- (U) COMPLETE:
 - (U) In-air quarter-scale laboratory demonstration of Machinery Support Structure System concept for shock performance. (AMSS)

B. (U) PROGRAM CHANGE SUMMARY: See total program change summary for P.E.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not applicable.

- (U) RELATED RDT&E:

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 11 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2224

PROGRAM ELEMENT TITLE: Surface Ship & Submarine
HM&E Advanced Technology

PROJECT TITLE: Ship & Submarine
HM&E Advanced Technology

- (U) PE 0601153N (Defense Research Sciences)
- (U) PE 0602121N (Ship, Submarine & Logistics Technology)
- (U) PE 0602131M (Marine Corps Landing Force Technology)
- (U) PE 0602233N (Human Systems Technology)
- (U) PE 0602234N (Materials, Electronics, and Computer Technology)
- (U) PE 0602314N (Undersea Warfare Surveillance Technology)
- (U) PE 0602315N (Mine Countermeasures, Mining and Special Warfare Technology)
- (U) PE 0603502N (Surface and Shallow Water Mine Countermeasures)
- (U) PE 0603513N (Shipboard System Component Development)
- (U) PE 0603514N (Ship Combat Survivability)
- (U) PE 0603553N (Surface Anti-Submarine Warfare)
- (U) PE 0603561N (Advanced Submarine Systems Development)
- (U) PE 0603563N (Ship Concept Advanced Design)
- (U) PE 0603564N (Ship Preliminary Design and Feasibility Studies)
- (U) PE 0603569E (ARPA S&T Program)
- (U) PE 0603573N (Advanced Surface Machinery Systems)
- (U) PE 0604558N (New Design SSN Development)
- (U) PE 0604561N (SSN-21 Developments)
- (U) Under the Defense S&T Reliance Agreement, the Navy has the lead for this Navy-unique program.

D. (U) SCHEDULE PROFILE: Not applicable

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 12 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

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(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 1998 ESTIMATE	FY 1999 ESTIMATE	FY 2000 ESTIMATE	FY 2001 ESTIMATE	FY 2002 ESTIMATE	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	TO COMPLETE	TOTAL PROGRAM
R2328 Project M	4,722	4,697	2,410	0	0	0	0	0	0	20,833

A. (U) MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Project M develops and demonstrates a technology to control the vibration of naval machinery support structures.

• (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1998 ACCOMPLISHMENTS (Congressional Plus-up (\$4,722)):

- (U) Efforts described in this project are funded at \$5M in Project R2224 controls.
- (U) Installed large scale support structure and associated test fixture in plant.
- (U) Developed electronics, sensors, magnets, and software for the demonstration system.
- (U) Prepared test plans for all subsystem and system level tests, including the final in water demonstration.
- (U) Installed components on the test fixture and test structure and integrate the demonstration system.
- (U) Conducted structural acoustic characterization tests of the test vehicle (PIKE) at the Intermediate Scale Measurement System (ISMS).

2. (U) FY 1999 PLAN (\$4,604):

- (U) Conduct in-plant system testing of the demonstration system.
- (U) Conduct in-air performance tests in plant.
- (U) Deliver Project M demonstration system to Naval Surface Warfare Center (NSWC) Carderock and install in Pike Model.

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 13 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

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PROGRAM ELEMENT TITLE: Surface Ship & Submarine
HM&E Advanced Technology

PROJECT TITLE: Project M

- (U) Conduct in-air demonstration testing of Project M in Pike model at NSWC Carderock.
- (U) Transport Project M demonstration system to the ISMS facility NSWC Bayview for in-water tests.
- (U) Conduct in-water demonstration tests of Project M technology at ISMS facility.

(U) (\$93) SMALL BUSINESS INNOVATION RESEARCH:

- (U) Portion of extramural program reserved for Small Business Innovation Research assessment in accordance with 15 U.S.C.638.

3. (U) FY 2000 PLAN (\$2,410):

- (U) Evaluate performance of Project M technology from in-water tests.
- (U) Complete transition of Project M technology to Naval Sea Systems Command.

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 14 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

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PROJECT NUMBER: R2328

PROGRAM ELEMENT TITLE: Surface Ship & Submarine
HM&E Advanced Technology

PROJECT TITLE: Project M

B. (U) PROGRAM CHANGE SUMMARY: See total program change summary for P.E.

C. (U) OTHER PROGRAM FUNDING SUMMARY: Not applicable.

(U) RELATED RDT&E:

(U) PE 0601153N (Defense Research Sciences)

(U) PE 0602121N (Ship, Submarine & Logistics Technology)

(U) PE 0602122N (Aircraft Technology)

(U) PE 0602234N (Materials, Electronics, and Computer Technology)

(U) PE 0603573N (Advanced Surface Machinery Systems)

(U) PE 0604558N (New Design SSN Development)

(U) PE 0604561N (SSN-21 Development)

(U) Under the Defense S&T Reliance Agreement, the Navy has the lead for this Navy-unique program.

D. (U) SCHEDULE PROFILE: Not applicable

R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 15 of 16)

UNCLASSIFIED

UNCLASSIFIED

FY 2000 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET

DATE: February 1999

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N

PROJECT NUMBER: R2328

PROGRAM ELEMENT TITLE: Surface Ship & Submarine
HM&E Advanced Technology

PROJECT TITLE: Project M

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R-1 Line Item 20

Budget Item Justification
(Exhibit R-2, Page 16 of 16)

UNCLASSIFIED